LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA8 | The Chalfonts and Amersham

Data appendix (AG-001-008)

Agriculture, forestry and soils

November 2013

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Department for Transport

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High Speed Two (HS2) Limited,
Eland House,
Bressenden Place,
London SW1E 5DU

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1 Introduction

1.1.1 The agriculture, forestry and soils appendix for the Chalfonts and Amersham community forum area (CFA8) comprises:

- soils and Agricultural Land Classification (ALC) surveys (Section 2);
- forestry (Section 3); and
- farm impact assessment summaries (Section 4).

1.1.2 Maps referred to throughout the agriculture, forestry and soils appendix are contained in the Volume 5, Agriculture, Forestry and Soils Map Book.

2 Soils and Agricultural Land Classification surveys

2.1 Background

2.1.1 The agricultural baseline data has been derived from both desk study and site investigation. Information gathered by the desk study has related primarily to the identification of soil resources in the study area, the associated physical characteristics of geology, topography and climate which underpin the assessment of agricultural land quality, and the disposition of land uses. The main sources of information have included:

- National Soil Map[1];
- Soils and Their Use in South East England[2];
- solid and superficial deposits from the Geology of Britain viewer[3];
- gridpoint meteorological data for Agricultural Land Classification of England and Wales[4];
- Provisional Agricultural Land Classification of England and Wales (1:250,000)[5];
- Likelihood of Best and Most Versatile Agricultural Land (1:250,000)[6];
- agri-environment schemes[7];
- computer-aided light detection and ranging (LiDAR) elevation data for determination of gradient; and
- aerial photography.

2.1.2 Where the collection of agricultural site information has enabled a review/refinement of published information this was undertaken in accordance with the methodology prescribed by the Ministry of Agriculture, Fisheries and Food (MAFF)[8].

2.1.3 Engagement with landowners and tenants between May 2012 and June 2013 has established the nature and extent of agricultural, forestry and related rural enterprises. Information obtained from farm impact assessment interview surveys has been taken as a factual representation of local agricultural and forestry interests and has not been subject to further evaluation.

[1] Cranfield University (2001), *The National Soil Map of England and Wales* 1:250,000 scale.
[2] Soil Survey of England and Wales (1984), *Soils and Their Use in South East England*.
[3] British Geological Survey. http://mapapps.bgs.ac.uk/geologyofbritain/home.html: Accessed on 18 March 2013
[4] Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations.*
[5] Ministry of Agriculture, Fisheries and Food (1983), *Agricultural Land Classification of England and Wales* (1:250,000).
[6] Department for Environment, Food and Rural Affairs (Defra) (2005), *Likelihood of Best and Most Versatile Agricultural Land* (1:250,000).
[7] Multi-Agency Geographical Information for the Countryside (MAGIC) available on line @ www.magic.gov.uk, Accessed August 2013.
[8] MAFF, (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land.*

2.2 Soils and land resources

2.2.1 The location and extent of soil types displaying different characteristics and of agricultural land in the different ALC grades are influenced by topography, drainage, geology and soil parent material, which are described in turn below. This section then provides a description and distribution of the main soil types encountered along the study corridor.

Topography and drainage

2.2.2 Almost all of the study area falls within the Chilterns Area of Outstanding Natural Beauty (AONB). North of Chalfont St Giles, the extensive dip slope of the Chilterns is incised by numerous dry valleys creating a characteristic landscape pattern of valleys and ridges. The highest point in the area is at approximately 160m above Ordnance Datum (AOD). The principal drainage is provided by the River Misbourne which traverses the area with the valley and the river floodplain at between 70 and 80m AOD.

Geology and soil parent materials

2.2.3 The principal underlying geology mapped by the British Geological Survey (BGS) is soft to medium-hard chalk of the Seaford and Newhaven Chalk formations belonging to the Cretaceous White Chalk subgroup (a soft limestone). Along the river valley the New Pit and Lewes Nodular Chalk formations are mapped. The chalk outcrops form a long north-east to south-west escarpment facing north-west. There is a long backslope which gradually falls to the south-east and which is covered by various plateau drift deposits.

2.2.4 To the northwest the chalk scarp has outwash deposits at its foot which give way to the underlying clay. Small areas of the Lambeth Group are also mapped on slopes in the south-east of this study area and comprise sand, silt and clay while further to the northwest is found an extensive clay plain formed on the Kimmeridge Clay.

2.2.5 At the southern end of the route superficial deposits comprise alluvial sand and gravel associated with the River Misbourne. Superficial deposits are generally absent from the northern half of the route section although a small area of Clay-with-Flints is evident to the west of Amersham Old Town. The route will also cross an area of gravel deposits that outcrop along Whielden Lane extending towards Amersham Old Town.

2.2.6 Superficial deposits of Quaternary sands and gravels overlie the bedrock at the highest altitudes in most of the study area except for areas west of Amersham where superficial Clay-with-Flints is mapped overlying the geology of the Lambeth Group. On the top slopes to the north west of the section superficial deposits of the Clay-with-Flints are mapped.

2.2.7 Alluvial deposits of clay, silt, sand and gravel are present in the valley along the floodplain.

2.2.8 A list of geological strata occurring within the study area is provided in age order in Table 1 and shown on Map WR-02-008 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

Table 1: Bedrock and soil forming materials

Formation	Composition/soil parent material
Kimmeridge Clay	Calcareous of kerogen-rich silty or sandy mudstones with thin siltstone and cementstone beds
New Pit Chalk	Firm to moderately hard chalk with marls and sporadic flints
Lewes Nodular Chalk	Hard to very hard nodular chalks with interbedded soft to medium chalks
Seaford Chalk	Firm white chalk with semi-continuous nodular and tabular flint seams
Newhaven Chalk	Soft to medium-hard, smooth white chalks with marl seams and flint bands
Lambeth Group	Fine grained sands, silts and clays with localised pebble beds
Superficial deposits	
Alluvium	Compressible silty clay, (silt, sand and gravel)
Head	Poorly sorted and poorly stratified gravel, sand and clay depending on upslope source

Description and distribution of soil types

2.2.9 The characteristics of the soils are described by the Soil Survey of England and Wales[2] and shown on the National Soil Map[1]. The soils are grouped into associations of a range of soil series showing similar characteristics.

2.2.10 The National Soil Map shows loamy soils across the study area which vary in characteristics between lime rich and acidic and well-drained and poorly-drained. The soils mapped by the Soil Survey of England and Wales range from the versatile, well-drained loamy topsoils over clay of the Marlow association to the imperfectly to poorly-drained alluvial soils of the Frome association.

2.2.11 Frome and Coombe 1 soils are mapped in association with the River Misbourne. Both are characterised by silty and clayey loam soils overlying chalk, the difference between them being drainage status. The Frome soils mark the immediate floodplain and hence are understandably wet often being assessed as Wetness Class IV[9] (WC IV). Due to the underlying chalk and their occurrence on valley sides Coombe 1 soils are well drained and of WC I. Variation within the Coombe 1 association is related to the thickness of the drift over chalk and the association can be very stony. The soils are shown in a general landscape context in Figure 1 which gives a pictorial representation of the relationship between geology, topography and soil characteristics.

2.2.12 To the south east of the area the Marlow association dominates and is typically well or moderately well-drained (WC I or II) loam over clay soil containing flints. To the west of the river on the slopes south of Amersham the flinty and chalky soils of the Batcombe, Hornbeam 2 and Sonning 2 associations are mapped. These soils typically

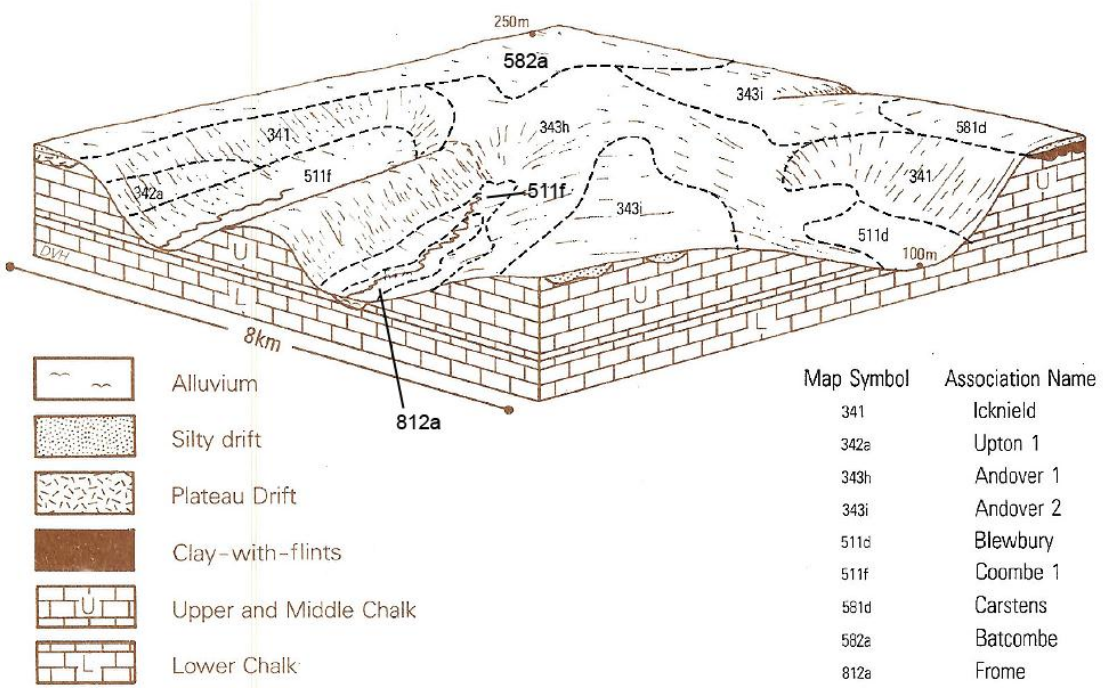
[9]The Wetness Class (WC) of a soil is classified according to the depth and duration of waterlogging in the soil profile and has six bands.

develop in Plateau Drift or Clay-with-Flints which cap high chalky plateaux and are moderately well draining of WCII - III. These soils are shown in a landscape context in Figure 2.

2.2.13 The final major unit of soil mapped is the Essendon association in the north-west of the study area which is developed in gravelly material and comprises flinty and loamy soils over clay. Although mapped on slopes and hilltops Essendon soils remain imperfectly to poorly drained (WC III to IV).

2.2.14 Where profile descriptions are available the predominant soil series of each association is described in Table 2 (taken from the Soils Guide). References made to soil colours are derived from a standard Munsell Soil Colour Chart[10]. Other technical references are defined by the Soil Survey of England and Wales.

Figure 1: Coombe 1 (511f), Batcombe (582a) and Frome (812a) soil associations in a landscape context [11]



[10] Munsell Color *(2000), Munsell Color Charts*, Munsell Color, Grand Rapids, MI, USA.
[11] National Soil Resources Institute (NSRI) 2013. *The Soils Guide*. Cranfield University, UK Available: http://www.landis.org.uk/; Accessed August 2013

Figure 2: Batcombe (582a) and Hornbeam 2 (582c) soil associations in a landscape context [12]

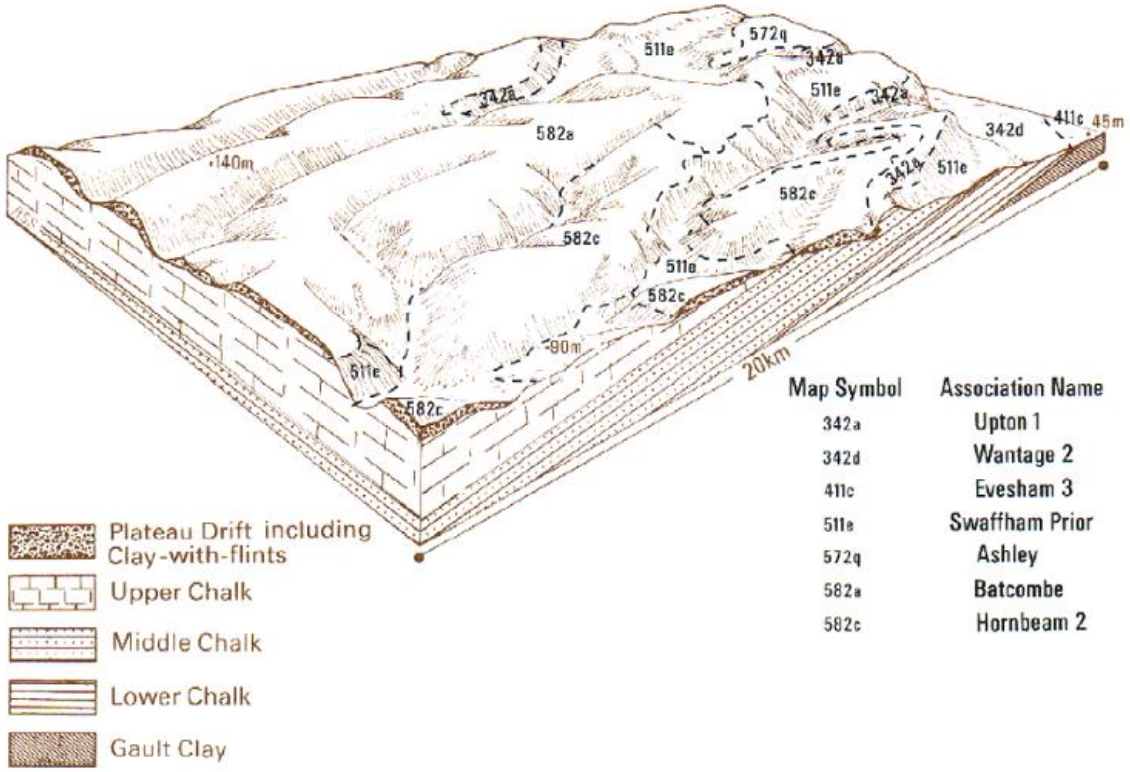


Table 2: Dominant soil series

Frome series	Coombe series	Marlow series	Hornbeam series	Essendon series
0cm-8cm, very dark greyish brown (10YR3/2)[13], very slightly stony silty clay loam; small rounded flint; moist; moderately developed fine subangular blocky; low packing density; moderately weak soil and ped strength; abundant very fine fibrous roots; very calcareous; clear smooth boundary	0cm-25cm, dark brown (10YR3/3) slightly stony silty clay loam; medium angular flint; moist; strongly developed medium packing density; moderately weak soil and ped strength; many very fine fibrous roots; very calcareous; sharp smooth boundary	0cm-28cm, dark brown (10YR3/3) moderately stony sandy clay loam; medium subangular and platy flint; moist; moderately developed fine angular blocky; medium packing density; moderately weak soil strength; many fine fibrous roots; non-calcareous; abrupt smooth boundary	0cm-25cm, dark greyish brown (10YR4/2) slightly stony clay loam with few fine brown (7.5YR5/4) mottles; small rounded flint; very moist; weakly developed coarse subangular blocky; medium packing density; moderately firm soil strength; common very fine fibrous roots; very slightly calcareous; few rounded ferrimanganiferous nodules; abrupt smooth boundary	0cm-8cm, black (7.5YR2/1) stoneless loamy peat; very moist; moderately developed coarse granular; low packing density; common medium woody roots and bracken rhizomes; non-calcareous; sharp smooth boundary

[12] National Soil Resources Institute (NSRI) 2013. *The Soils Guide*. Cranfield University, UK Available: http://www.landis.org.uk/; Accessed August 2013.

[13] Munsell colour notation describes colour by three attributes: hue (with five principal colours - red (R), yellow (Y), green (G), blue (B), and purple (P) with a preceding intermediate value 2.5-10); value or brightness where zero is black (most dark) and ten is white (most light); and chroma that distinguishes the difference from a pure hue to a grey shade.

Frome series	Coombe series	Marlow series	Hornbeam series	Essendon series
8cm-47cm, light brownish grey (10YR6/2) very slightly stony silty clay loam; many fine reddish yellow (7.5YR6/8) mottles; small rounded flint; moist; moderately developed medium prismatic with greyish brown (10YR5/2) faces; medium packing density; moderately firm ped strength; many very fine fibrous roots; very calcareous; clear wavy boundary	25cm-44cm, brown to dark brown (7.5YR4/4) moderately stony silty clay loam; very small subrounded chalk; moist; strongly developed fine subangular blocky; medium packing density; moderately weak soil and ped strength; common very fine fibrous roots; very calcareous; abrupt irregular boundary with fine chalk gravel in the bottom of tongues	28cm-48cm, brown (7.5YR5/2) slightly stony sandy clay loam; medium subangular and platy flint; moist; moderately developed fine angular blocky; medium packing density; moderately weak soil strength; common fine fibrous roots; non-calcareous; few ferrimanganiferous nodules; common clay coats; abrupt smooth boundary	25cm-42cm, brown to dark brown (10YR4/3) slightly stony clay loam with few fine brown to dark brown (7.5YR4/4) mottles; medium rounded flint; slightly moist; strongly developed medium subangular blocky; medium packing density; moderately firm ped strength; common very fine fibrous roots; non-calcareous; common rounded ferri-manganiferous nodules; clear wavy boundary	8cm-25cm, light brownish grey (10YR6/2) moderately stony fine sandy silt loam with common medium brown to dark brown (7.5YR4/2) and yellowish brown (10YR5/6) mottles; medium rounded flint; very moist; weakly developed medium subangular blocky; low packing density; moderately firm soil strength; common medium woody roots; non-calcareous; clear smooth boundary
47cm-100cm, extremely stony with slightly calcareous sandy loam interstitial material; very small to large flint, quartz and chalk; wet	44cm-80cm, very pale brown (10YR7/4) moderately stony sandy silt loam; very small subrounded chalk with some large patches with medium chalk fragments and large flints; moist; massive; medium packing density; moderately strong soil strength; extremely calcareous	48cm-86cm, yellowish red (5YR5/6) moderately stony clay; medium subangular and platy flint; moist; strongly developed medium angular blocky with brown (7.5YR5/4) faces; medium packing density; moderately firm ped strength; common fine fibrous roots; non-calcareous; common soft ferri-manganiferous concentrations; many clay coats; gradual smooth boundary	42cm-53cm, brown (10YR5/3) moderately stony clay loam with many medium light brownish grey (2.5Y6/2) pale brown (10YR6/3) and strong brown (7.5YR5/8) mottles; medium subrounded flint; very moist; strongly developed medium subangular blocky; medium packing density; moderately firm ped strength; common very fine fibrous roots; non-calcareous; common rounded ferrimanganiferous nodules; few clay coats; sharp smooth boundary	25cm-40cm, light brownish grey (2.5Y6/2) slightly stony clay loam with many medium strong brown (7.5YR5/8) mottles; medium rounded flint and quartz; wet; moderately developed coarse angular blocky; medium packing density; moderately firm soil strength; common medium woody roots; non-calcareous; clear wavy boundary
No record below 100cm	No record below 80cm	86cm-102cm, reddish brown (5YR5/4) moderately stony clay; medium subangular and platy flint; moist; strongly developed fine angular blocky with yellowish red (5YR5/6) faces; medium packing density; moderately	53cm-93cm, strong brown (7.5YR5/6) slightly stony clay with common medium greyish brown (2.5Y5/2) and strong brown (7.5YR5/8) mottles; very large subrounded flint; very moist; moderately developed coarse	40cm-65cm, strong brown (7.5YR5/8) slightly stony clay with many medium grey (5Y5/1) and red (2.5YR5/8) mottles; medium rounded flint and few quartz; wet; strongly developed coarse angular blocky with grey (10YR5/1)

Frome series	Coombe series	Marlow series	Hornbeam series	Essendon series
		firm ped strength; few fine fibrous roots; non-calcareous; many ferri-manganiferous concretions; many clay coats; abrupt wavy boundary	angular blocky with greyish brown (2.5Y5/2) faces; high packing density; very firm soil and ped strength; few very fine fibrous roots; non-calcareous; common irregular soft ferri-manganiferous concretions; many stress oriented coats	faces; high packing density; moderately firm ped strength; common fine woody roots; non-calcareous; gradual smooth boundary
		102cm-110cm, light brown (7.5YR6/4) slightly stony silty clay loam; small subrounded, chalk; moist; massive; high packing density; very firm soil strength; few fine fibrous roots; very calcareous		65cm-95cm, strong brown (7.5Yr5/8) slightly stony clay with many medium grey (5Y5/1) and common medium red (2.5YR4/8) mottles; medium rounded flint; wet; strongly developed coarse angular blocky with grey (5Y5/1) faces; high packing density; moderately firm ped strength; few medium woody roots; non-calcareous

2.3 Soil and land use interactions

Agricultural land quality

2.3.1 A review of background ALC information has been undertaken to ascertain the quality of the agricultural land quality in the study area with detailed post-1988 ALC data available for two sites.

Detailed Agricultural Land Classification

2.3.2 The existing ALC surveys show agricultural land quality to vary between very good quality Grade 2 and poor quality Grade 4 with a majority of Subgrade 3b. This variability can be attributed to the different geological units and deposits causing different soil properties to develop.

2.3.3 Collectively these surveys assessed approximately 9ha as Grade 2 (11%), 9ha of Subgrade 3a (11%), 62ha of Subgrade 3b (77%) and 0.5ha of Grade 4 quality land (1%).

Desktop assessment of Agricultural Land Classification

2.3.4 The study area has been subject to an intensive desk-based assessment which has relied on the interpretation of soil mapping, topography and agro-climatic data, and the interactions between each factor. This resulted in an assessment of the likely soil textures, soil drainage status, landform, gradient, presence of or depth to poorly

permeable soil layers and the extent to which crop growth may be limited by soil droughtiness.

2.3.5 Professional judgement has then been made as to the predominant ALC grade which is likely for a soil with the given characteristics found in the climatic zone of the location within the study area. The judgement is influenced by the surveyor's experience of previous surveys in the locality and on similar soil types. The resulting grade is that which is considered to be the most likely grade that would be found should a detailed site investigation be conducted although this does not mean in all cases that that grade will be found in practice.

2.3.6 Context land quality was ascertained using information derived from the provisional ALC maps of England and Wales produced by the MAFF in the 1960s and 1970s. These maps show the section to be provisionally mapped as Grade 3, good to moderate quality land. These maps were originally published at a scale of 1:63,360 and are available at a scale of 1:250,000 in paper and digital formats. The main limitations of these provisional maps are that they are published on strategic scales only and according to a methodology which has since been revised twice. Therefore they cannot be used to definitively classify individual sites and further data analysis was conducted.

Agro-climatic data

2.3.7 The influence of climate on soil wetness is assessed by reference to median field capacity days (FCD) when the soil moisture deficit is zero, to WC and to topsoil texture. Droughtiness is determined by comparing the crop-adjusted available water capacity of the soil with the moisture deficit in the locality for wheat and potatoes. The calculation used to determine the severity of this limitation is given in Figure 3.

Figure 3: Methodology for calculating the severity of a droughtiness limitation to Agricultural Land Classification grading [14]

$$\text{AP wheat (mm)} = \frac{TA_{vt} \times LT_t + \Sigma (TA_{vs} \times LT_{50}) + \Sigma (EA_{vs} \times LT_{50\text{-}120})}{10}$$

where
TA_{vt} is Total available water (TA_v) for the topsoil texture
TA_{vs} is Total available water (TA_v) for each subsoil layer
EA_{vs} is Easily available water (EA_v) for each subsoil layer
LT_t is thickness (cm) of topsoil layer
LT_{50} is thickness (cm) of each subsoil layer to 50 cm depth
$LT_{50\text{-}120}$ is thickness (cm) of each subsoil layer between 50 and 120 cm depth
Σ means 'sum of'.

$$\text{AP potatoes (mm)} = \frac{TA_{vt} \times LT_t + \Sigma (TA_{vs} \times LT_{70})}{10}$$

where
LT_{70} is thickness (cm) of each subsoil layer to 70 cm depth

MB (Wheat) = **AP** (Wheat) **- MD** (Wheat)
MB (Potatoes) = **AP** (Potatoes) **- MD** (Potatoes)

Where
MB is the Moisture Balance
AP is the Crop-adjusted available water capacity
MD is the moisture deficit, as determined by the agro-climatic assessment.

Table 8 Grade according to droughtiness

Grade/ Subgrade	Moisture Balance limits (mm) *wheat*		*potatoes*
1	+30	*and*	+10
2	+5	*and*	-10
3a	-20	*and*	-30
3b	-50	*and*	-55
4	<-50	*or*	<-55

[14] Derived from: MAFF (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land.*

The local agro-climatic data have been interpolated from the Meteorological Office's standard 5km grid point data set for two points within the study area and which are set out in Table 3. The data show the area to be moderately cool and moist. The average number of FCD is 155 which is marginally greater than the average for lowland England (150 days) and is considered to be slightly unfavourable for providing opportunities for agricultural land working.

2.3.8 Fundamentally, climate in this study area does not in itself place any limitation upon land quality but the interactions of climate with soil characteristics are important in determining the wetness and droughtiness limitations of the land.

Table 3: Interpolated agro-climatic data

Agro-climatic parameter	Chalfont St Giles	Rodgers Wood
Altitude (AOD)	90m	130m
Average annual rainfall	717mm	740mm
Accumulated temperature above 0°C	1,405 day°	1,360 day°
Field capacity days	152 days	158 days
Average moisture deficit, wheat	104mm	101mm
Average moisture deficit, potatoes	95mm	91mm

Site limitations

2.3.9 The assessment of site factors is primarily concerned with the way in which topography influences the use of agricultural machinery and hence the cropping potential of land. Gradient and microrelief, with complex changes of slope angle or direction over short distances, may be a limiting factor to the ALC grading between Chalfont St Giles and Amersham where the landscape rises up from the river valley.

2.3.10 Flooding is limited to the floodplains of the River Misbourne through the centre of the study area and its tributaries. Although flooding can downgrade agricultural land there is insufficient data available to downgrade agricultural land according to flooding here.

Soil limitations

2.3.11 The main soil properties which affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility. Together they influence the functions of soil and affect the water availability for crops, drainage, workability and trafficability. The main soil characteristics within the study area are:

- alluvial silty and clayey textured profiles which are poorly drained;
- moderately well draining silty and clayey soils capping high chalky plateaux; and
- well drained loamy, flinty soils developed over chalk.

Interactive limitations

2.3.12 The physical limitations which result from interactions between climate, site and soil are soil wetness, droughtiness and susceptibility to erosion. Each soil can be allocated a WC based on soil structure, evidence of waterlogging and the number of FCD; the topsoil texture then determines its ALC Grade according to Table 6 of the MAFF ALC guidelines (Figure 4).

2.3.13 Soils of the Frome association have silty clay loam topsoils and are most typically of WC IV due to waterlogging by high groundwater. Soils of this texture which are of WC IV and in an area with an average of 155 FCD are assessed as Subgrade 3b, moderate quality.

2.3.14 Moderately to well draining fine silty or fine loamy soils of the Marlow, Batcombe, Hornbeam 2, and Sonning 2 associations may be assessed as any of Grades 1 to 3b, depending upon the specific proportions of each soil component (sand, silt and clay) present and the WC it falls into. Using the example profile descriptions given in Table 2 it has been calculated that the Marlow profile is of WCII which, in combination with a sandy clay loam topsoil, results in a soil wetness limitation to Grade 2. The Hornbeam series profile is of WC III which, with a clay loam topsoil, will limit the profile to Subgrade 3a or Subgrade 3b, depending on whether the clay content is above or below 27% respectively.

2.3.15 Under the climatic conditions of the study area soils which are well draining and overlying porous chalk are most likely to be best and most versatile (BMV) (Grades 1, 2 and Subgrade 3a) according to soil wetness and workability. Due to their free-draining characteristics and flint content Coombe and some Marlow, Batcombe, Hornbeam 2, and Sonning 2 association soils in this location are also downgraded to a minor extent by droughtiness to Grade 2 or Subgrade 3a.

Figure 4: Agricultural Land Classification grade according to soil wetness [15]

Wetness Class	Texture[1] of the top 25 cm	Field Capacity Days <126	126-150	151-175	176-225	>225
	S[2] LS[3] SL SZL	1	1	1	1	2
	ZL MZCL MCL SCL	1	1	1	2	3a
I	HZCL HCL	2	2	2	3a	3b
	SC ZC C	3a(2)	3a(2)	3a	3b	3b
	S[2] LS[3] SL SZL	1	1	1	2	3a
	ZL MZCL MCL SCL	2	2	2	3a	3b
II	HZCL HCL	3a(2)	3a(2)	3a	3a	3b
	SC ZC C	3a(2)	3b(3a)	3b	3b	3b
	S[2] LS SL SZL	2	2	2	3a	3b
	ZL MZCL MCL SCL	3a(2)	3a(2)	3a	3a	3b
III	HZCL HCL	3b(3a)	3b(3a)	3b	3b	4
	SC ZC C	3b(3a)	3b(3a)	3b	4	4
	S[2] LS SL SZL	3a	3a	3a	3b	3b
	ZL MZCL MCL SCL	3b	3b	3b	3b	3b
IV	HZCL HCL	3b	3b	3b	4	4
	SC ZC C	3b	3b	3b	4	5
	S LS SL SZL	4	4	4	4	4
	ZL MZCL MCL SCL	4	4	4	4	4
V	HZCL HCL	4	4	4	4	4
	SC ZC C	4	4	4	5	5
Soils in Wetness Class VI - Grade 5						

[1]For naturally calcareous soils with more than 1% $CaCO_3$ and between 18% and 50% clay in the top 25 cm, the grade, where different from that of other soils, is shown *in brackets*

[2] Sand is not eligible for Grades 1, 2 or 3a

[3] Loamy sand is not eligible for Grade 1

Where: S = sand, Z = silt, C = clay, L = loamy and P= peat.

For sand the coarseness of the grain is sub-divided into coarse (c), medium (m) and fine (f). The subdivisions of clay loam and silty clay loam classes are indicated as medium (M) (less than 27% clay); heavy (H) (27-35% clay).

The average number of FCD in The Chalfonts and Amersham area is 155, and shown in the highlighted column.

[15] Derived from: MAFF (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land.*

3 Forestry

3.1.1 Assessment of forestry resources has primarily had regard to the National Forest Inventory[16]. The area of land under forestry (i.e. trees and woodland) within 2km either side of the route centre line has been derived using a Geographic Information System (GIS), and is shown in Table 4.

3.1.2 There are significant areas of woodland throughout the study area many of which are associated with large estates. Large woodlands include Hodgemoor Wood, Pollards Wood and Penn Wood.

Table 4: Area of woodland within the study area and construction boundary

	Area of forestry land (ha)	**Forestry land as a % of total land area**
Forestry land in 4km-wide study area	934	21% (forestry as a land use within 4km-wide study area)
Forestry land within construction boundary	2.1	Approximately 5% of the land required for the construction of the Proposed Scheme is presently wooded

[16] Forestry Commission (2001), National Forest Inventory Woodland and Ancient Woodland (as updated).

4 Assessment of effects on holdings

4.1.1 The effects on holdings have been assessed through a series of interviews with farmers along the proposed route carried out between May 2012 and June 2013 as well as measurements of the applicable area of land required according to the methodology set out in Technical Note AG5 (within Volume 5: Appendix CT-001-000/2).

4.1.2 The nature of impacts considered comprises the temporary and permanent land required from the holding, the temporary and permanent severance of land, the permanent loss of key farm infrastructure and the imposition of disruptive effects (particularly noise and dust) on land uses and the holding's operations. These impacts occur primarily during the construction phase of the Proposed Scheme and are set out in Table 5.

Table 5: Summary of assessment of effect on holdings

Holding reference, name and description	**Construction effects**	**Residual effects post restoration of land required temporarily**
CFA08/1 Ashwell's Farm 9ha of grazing land let to third party Low sensitivity to change	Land required: 3.8ha (43%). High impact Severance: although the holding is severed by proposed tree planting, provided access is maintained (as described in the draft Code of Construction Practice[17] (CoCP)) there will be no severance impact. Negligible impact Disruptive effects: no impact on agricultural activity: construction dust and noise controlled via the mitigation measures set out within the draft CoCP. Negligible impact	Land required: 3.3ha (37%). High impact Severance: although the holding is severed by tree planting provided access is maintained (as described in the draft CoCP) there will be no severance impact. Negligible impact Infrastructure: no buildings or other farm infrastructure affected. Negligible impact
	Overall temporary assessment: moderate effect due to proportion of holding removed and low sensitivity	Overall permanent assessment: moderate effect due to proportion of holding removed and low sensitivity
CFA08/2 Upper Bottom House Farm (including Chalfont Valley Equestrian) 162ha arable, beef cattle and equestrian enterprise Medium sensitivity to change	Land required: 3.1ha (2%). Negligible impact Severance: no new severance. Negligible impact Disruptive effects: although construction noise will be controlled via the mitigation measures set out within the draft CoCP this equestrian unit will experience disruptive construction effects that will require some of the activities to be modified or relocated. No nuisance arising from road upgrade as accessible at all times - including for the	Land required: 1.7ha (1%). Negligible impact Severance: no new severance. Negligible impact Infrastructure: manège demolished - although the principal land use - agriculture - will not cease; scale of equestrian livery may need to be reduced if replacement structure not available. Medium impact

[17] (Volume 5: Appendix CT-003-000)

Holding reference, name and description	Construction effects	Residual effects post restoration of land required temporarily
	milk delivery business. Medium impact	
	Overall temporary assessment: moderate effect due to disruptive effects during construction, in part due to the loss of the manège	Overall permanent assessment: moderate effect due to loss of infrastructure
CFA08/3 * Shardeloes Farm 140ha arable and equestrian enterprise Medium sensitivity to change	Land required: 1.1ha (1%) Negligible impact Severance: no severance. Negligible impact Disruptive effects: no impact on agricultural activity: construction dust and noise controlled via the mitigation measures set out within the draft CoCP. Negligible impact	Land required: 0.5ha (< 1%) Negligible impact Severance: no severance. Negligible impact Infrastructure: no buildings or other farm infrastructure affected. Negligible impact
	Overall temporary assessment: negligible effect	Overall temporary assessment: negligible effect
CFA08/4 Lower Bottom House Farm 121ha of grassland land. Let for grazing or hay crop taken. Low sensitivity to change	Land required: 8.8ha (7%). Low impact Severance: no severance. Negligible impact Disruptive effects: no impact on agricultural activity: construction dust and noise controlled via the mitigation measures set out within the draft CoCP. Negligible impact	Land required: 3.5ha (3%). Negligible impact Severance: no severance. Negligible impact Infrastructure: no buildings or other farm infrastructure affected. Negligible impact
	Overall temporary assessment: negligible effect	Overall temporary assessment: negligible effect
CFA08/5 * Bereleigh Farm 60ha arable Medium sensitivity to change	Land required: 1.1ha (2%). Negligible impact Severance: no severance. Negligible impact Disruptive effects: no impact on agricultural activity: construction dust and noise controlled via the mitigation measures set out within the draft CoCP. Negligible impact	Land required: < 0.1ha (< 1%). Negligible impact Severance: no severance. Negligible impact Infrastructure: no buildings or other farm infrastructure affected. Negligible impact
	Overall temporary assessment: negligible effect	Overall temporary assessment: negligible effect
CFA08/6 * Penn House Estate 25.0ha arable Medium sensitivity to change	Land required: 0.2ha (1%). Negligible impact Severance: no severance. Negligible impact Disruptive effects: no impact on agricultural activity: construction dust and noise controlled via the mitigation measures set out within the draft CoCP.	Land required: 0ha (0%). Negligible impact Severance: no severance. Negligible impact Infrastructure: no buildings or other farm infrastructure affected. Negligible impact

Holding reference, name and description	Construction effects	Residual effects post restoration of land required temporarily
	Negligible impact	
	Overall temporary assessment: negligible effect	Overall temporary assessment: negligible effect

* No Farm Impact Assessment interview conducted; data estimated

5 References

British Geological Survey. http://bgs.ac.uk/geologyofbritain/home/html: Accessed on 18 March 2013.

Cranfield University (2001), *The National Soil Map of England and Wales* 1:250,000 scale.

Department for Environment, Food and Rural Affairs (Defra) (2005), *Likelihood of Best and Most Versatile Agricultural Land* (1:250,000).

Forestry Commission (2001), *National Forest Inventory Woodland and Ancient Woodland (as updated)*.

Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations*.

Ministry of Agriculture, Fisheries and Food (1983), *Agricultural Land Classification of England and Wales* (1:250,000).

Ministry of Agriculture, Fisheries and Food (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land*.

Multi-Agency Geographical Information for the Countryside (MAGIC) available online @ www.magic.gov.uk. Accessed August 2013.

Munsell Color Charts (2000), Munsell Color, Grand Rapids, MI, USA.

Soil Survey of England and Wales (1984), *Soils and Their Use in South East England*.